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$$\therefore \phi(x)\Gamma(1+x)=\frac{d}{dx}\Gamma(1+x)=\frac{d}{dx}\int_0^\infty z^x e^{-z}dz=\int_0^\infty z^x e^{-z}\log z dz.$$

Put $x=0$; and since $\Gamma(1)=1$, we have

$$\phi(0)=\int_0^\infty e^{-z}\log z dz. \qquad \therefore C=-\phi(0)=\int_0^\infty e^{-z}\log\left(\frac{1}{z}\right)dz$$

which gives Euler's constant.

MECHANICS.

234. Proposed by C. N. SCHMALL, 89 Columbia Street, New York City.

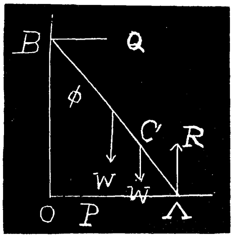
A ladder is placed with one end resting against a smooth wall and making with it an angle ϕ. Also, the roughness of the ground prevents it from slipping. A man weighing as much as the ladder ascends to the top. Taking μ as the coefficient of friction, prove:

(a) The ladder will slip before he gets to the top if $\phi>\tan^{-1}4\mu/3$.

(b) If the ascent be feasible, there will be three times as much friction when he is at the top as when he is at the bottom, (See Jeans' *Theoretical Mechanics*, p. 47.)

I. Solution by J. SCHEFFER, A. M., Kee Mar College, Hagerstown, Md.

Let $AB=c$ be the ladder; let some position of the man be at C, AC being $=a$. Let the reaction at A and B be, respectively, $=P$ and Q, and the ladder be uniform, that is, its weight W acting at the mid-point of AB; the friction $P\mu$ acts along AO. Resolving along AO and BO, we have $Q=P\mu$, $P=2W$, and the equation of the moments with reference to A, $W(a+\frac{1}{2}c)\sin\phi=Qc\cos\phi=2W\mu c\cos\phi$; whence $\tan\phi=\frac{4c\mu}{2a+c}$. For $a=c$, $\tan\phi=\frac{4\mu}{3}$, $Q=\frac{1}{2}W\tan\phi=\frac{2}{3}W\mu . P\mu=2W\mu$.



II. Solution by S. G. BARTON, Ph. D., Clarkson School of Technology, Potsdam, N. Y.

Let $2l$ be the length of the ladder, R the pressure on the ground, R' the pressure on the wall. Assuming that the man is at the top and that the ladder is about to slip, equating the sums of the vertical and horizontal forces to zero and taking moments about the foot of the ladder, we find

$$R=2W, \quad F=\mu R=R', \quad R'.2l\cos\phi=Wl\sin\phi+W.2l\sin\phi=3Wl\sin\phi.$$

Whence, $2R'=3W\tan\phi$. But $R'=2\mu W$. Therefore, $4\mu=3\tan\phi$ or $\phi=\tan^{-1}(4\mu/3)$. A larger value of ϕ makes $R'>F$, and the man cannot reach the top before slipping begins.

Friction, F, when the man is at top$=R'=\frac{3}{2}W\tan\phi$. When the man is at the bottom, the moment equation gives $R'.2l\cos\phi=Wl\sin\phi$. Whence $R'=\frac{1}{2}W\tan\phi$.

Hence, friction when at the top, is three times as great as when at the bottom.

Solved similarly by G. B. M. Zerr.

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PROBLEMS FOR SOLUTION.

ALGEBRA.

331. Proposed by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

Extract the square root of $21+6\sqrt{2}+2\sqrt{21}-6\sqrt{3}-6\sqrt{7}-2\sqrt{6}-2\sqrt{4}$ and also of $4\sqrt{2}+2\sqrt{6}-9-4\sqrt{3}$.

332. Proposed by C. N. SCHMALL, New York City.

Solve the quadratic, $x^2+ax+b=0$, without completing the square.

GEOMETRY.

359. Proposed by W. J. GREENSTREET, M. A., Stroud, England.

Two tangents are drawn to two confocal parabolas from any point on a common tangent. Show that the former two tangents and their chord of contact envelop yet another confocal parabola.

360. Proposed by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

A circular segment, area A, revolves successively about the diameters (fixed) d, d', intersecting at an angle θ. If v=volume about d, v' the volume about d', then $v^2+v'^2-2vv'\cos\theta$ is independent of the position of the segment.

361. Proposed by W. J. GREENSTREET, M. A., Stroud, England.

$ABCD$ is a quadrilateral. The bisectors of A and C meet in O_1; those of B and D meet in O_2. Find the tangent of the angle between AD and O_1O_2 in terms of sines and cosines of A, D, $A+B$, and $A+D$.

CALCULUS.

389. Proposed by G. W. DROKE, Professor of Mathematics, University of Arkansas.

Find the curve such that the rectangle under the perpendiculars from two fixed points on the normals be constant.